# Low-Level Radioactive Waste

Low-level radioactive waste (LLW) is produced by both commercial industry and the federal government through the daily operations of nuclear power plants, hospitals, universities, research institutions and numerous industries across the country. These wastes are the by-products of the beneficial uses of radioactive materials. For example, sealed sources, or capsules, of Cobalt-60 are used to sterilize medical instruments and are considered radioactive waste when no longer useful. Also, emergency exit signs containing tritium (a radioactive isotope of hydrogen) and smoke detectors containing Americium-241 are considered radioactive waste when they are ready for disposal.

Due to the potentially hazardous nature of radioactivity, the waste requires stringent controls for its proper handling, transportation, and disposal. The regulations that pertain to radioactive waste in our state are implemented by the Division of Radioactive Waste Management in DHEC's Bureau of Land and Waste Management.

**What is radioactivity?**

Radioactivity is a natural physical process whereby radiation is emitted from an unstable atom. Atoms are the very small particles that form elements (examples include hydrogen, iron, and uranium). Most atoms are stable and will never emit any radiation, but certain kinds of atoms have a large surplus of energy and will eventually release the energy in a concentrated form known as radiation. Radiation energy can be expelled from certain atoms in the form of particles or a burst of pure energy. Examples are:

Alpha particles → 2 protons and 2 neutrons expelled from an atom's nucleus
Beta particles → Electrons expelled from an atom's shell of spinning electrons
Gamma ray → A burst of wave energy similar to an x-ray

Although the effect of large acute radiation exposures can be detrimental to health, radiation can be very beneficial to society when used safely.

**Low-level radioactive waste**

Low-level radioactive wastes (LLW) currently being disposed of by shallow land burial in our state are solid in form or are liquids that have been solidified and are composed mainly of short-lived radioisotopes (generally having half-lives less than 30 years). LLW is also defined as waste that is neither high-level, transuranic, spent fuel, or uranium mill tailings. Examples of typical LLW include solidified liquids, resins and filters used for coolant water decontamination at nuclear power plants; contaminated clothing, glassware and paper; irradiated metals and radioactive gauges used in industry. The majority of LLW comes from the nuclear power industry.

**Low-level radioactive waste disposal**

LLW generated by federal defense and research facilities is normally disposed of at federally operated sites. Commercially generated LLW is disposed of at three commercially operated sites located in Richland, WA, Barnwell, SC and Clive, UT. The disposal of LLW in SC began in 1971 when Chem-Nuclear Systems (CNS) opened a 235-acre shallow land burial facility near Barnwell. CNS is licensed by SC DHEC, with delegated authority from the U.S. Nuclear Regulatory Commission, to handle, store and dispose of LLW. The license is renewed every five years, and the firm is required to pay an annual fee which offsets the state's expense for conducting regulatory activities. SC DHEC's Division of Radioactive Waste Management staff includes an on-site inspector at the disposal facility.

**What are the factors in choosing a disposal site?**

The primary factors that are examined in choosing a LLW burial site are population density, surface water and groundwater conditions, soil types and climate. An area with

few residents is preferred to decrease the likelihood that the public will be affected by site operations. One of the major concerns of LLW burial is water management. If the waste containers are in prolonged contact with excessive amounts of groundwater, the containers may be breached and radionuclide contaminants may be transported via moving groundwater. Therefore, burial in sandy areas (which may increase the percolation of rainwater ) is not appropriate in a humid climate. Clay soil like that found at the Barnwell Disposal Facility acts as a barrier to water coming in contact with the waste containers.

**How is waste buried?**

Waste is shipped to the Barnwell Disposal Facility by truck in government approved waste packages such as 55-gallon drums or large carbon steel boxes (vol.=100 $ft^3$) for Class A waste and specially designed high-integrity conainers (HIC's) within lead-shielded casks for Class B/C waste. All carriers of LLW must comply with applicable state and U.S. Department of Transportation regulations. All trucks and waste packages are inspected upon arrival at the Barnwell Disposal Facility.

There are three basic trench designs currently used at the Barnwell site: Class A, Class B/C, and slit trenches. They are specifically designed to accomodate different classes of waste. In 1995, the state required that all waste-filled packages buried at the Barnwell Disposal Facility be placed in large concrete vaults which keep water away from the waste and generally increase the stability of the waste thereby providing better protection of our environment.

About 65 per cent of the waste is Class A waste and is buried in a Class A trench. Class A waste packages are placed in cylindrical (486 $ft^3$) or rectangular (1040 $ft^3$) engineered concrete vaults. A Class A waste trench will accomodate about 5000 vaults.

CNS has only used about two-thirds of the site's burial space. Eventually the site will be closed and maintained by the state using funds collected from CNS.

**How is the public's health affected by LLW disposal?**

Radiation exposure to the public and to radiation workers due to activities associated with the Barnwell facility have been minimal and well within regulatory limits. In fact, the average person receives the vast majority of their annual radiation exposure from medical and dental x-rays and background radiation. Background radiation is a term used to collectively describe radiation from natural sources such as cosmic radiation produced by the sun and radiation produced by soils in the earth's crust.

**How is the state's environment affected by LLW disposal?**

CNS uses state of the art technology in waste handling and disposal to insure protection of our environment with the use of below grade concrete vaults. In an effort to virtually eliminate the possibility of radioactive contaminants reaching our groundwater in the future, a massive project to "cap" the entire disposal facility in phases was initiated in 1991. The engineered caps are designed to prevent rainwater from contacting the waste or waste containers. The multi-layered enhanced caps include a compacted clay layer that is a minimum of one foot thick, a geosynthetic clay liner (GCL), an impermeable 60 mil thick high density polyethylene liner, a sand drain layer and a sandy topsoil layer with various grasses planted on top.

**The Low-Level Radioactive Waste Policy Act**

The Low-Level Radioactive Waste Policy Act (1980) initiated the idea that LLW disposal facilities can best be provided through regional groups of states allied through interstate agreements called compacts whereby the states would enter into agreements regarding waste burial sites for their own generated waste. Currently, there are eight compacts with two to eight states each. Washington, DC; Puerto Rico and six states, including SC, are currently unaffiliated with a compact.

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